Issues and Trends in IT

13.0 Introduction

Information technology is associated with numerous benefits that have indeed enhanced our living standards. Unfortunately as mentioned earlier in **Chapter 1**, any new technology if not well utilized may cause serious problems and information technology or more specifically computers are not to be excluded from this category. This chapter will give an overview of the health, legal and ethical issues that need to be catered for with the use of computers. Various examples of how an individual's health can be affected when using a computer are described followed by the precautions that are required to avoid such problems. IT use is regulated by certain laws, hence common misuses of IT and a brief description of IT related laws in Mauritius are given. Copyright, an important issue in relation to computers, is then presented. Some ethical guidelines as to the proper use of IT are provided. Finally the new trends in IT today are introduced.

13.1 Health issues

Computers have become a common tool in the workplace, at home and even in schools today. Many people use computers for different tasks and recently it has been observed that people spend more and more time working on computers. Unfortunately, this has given rise to many side effects, especially in the workplace where the health of many people has been affected. It is therefore essential to know how to make healthy use of computers in order to avoid such problems. The following sections describe different health issues that need special attention when using computers.

13.1.1 Physical health concerns

If a person sits for long periods of time in an uncomfortable position while typing and looking at a computer screen, the following physical problems may arise:

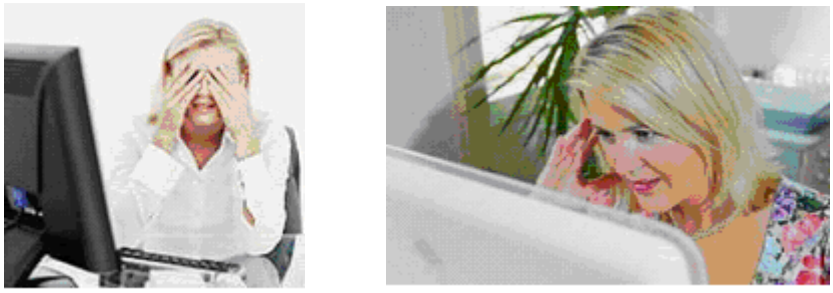
- **Eyestrain and headache**
  Fixing a glared screen for long periods of time and at a short distance eventually causes fatigue on our eyes. If not taken care of, this can result in eye strain problems and headache. Recommendations include:

  1. Taking a short fifteen minutes break for every hour.

  2. Use a good screen that does not flicker and is not blurred.

  3. Ensure that any light source is not reflected on the computer screen and if possible use anti glare shields.

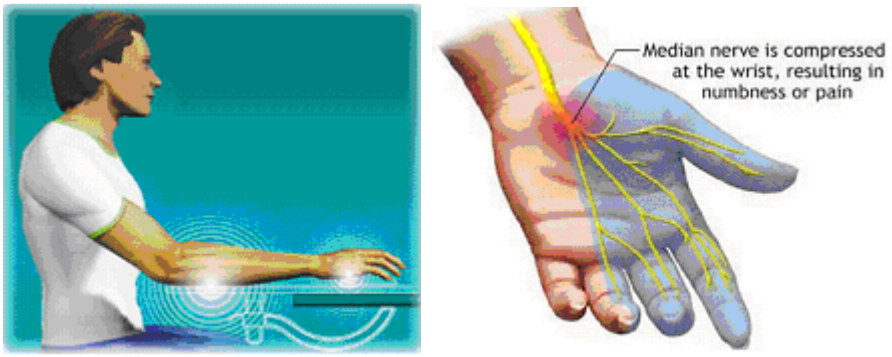
  4. Always use computers in a well lit room and keep the screen at a reasonable distance form you.



(a) (b)

Figure 13-1 (a) Eyestrain resulting from prolonged exposure to computer screen (b) Headache due to excessive working on computers

- **Repetitive strain injury (RSI)**
  This is the name given to a number of injuries that occurs especially in people who are involved in heavy repetitive work such that additional strain is imposed on their neck, fingers, hands, wrists and arms resulting in serious pains to different body parts that need medical care. **Carpal tunnel syndrome** is one type of RSI that affects mostly people who use keyboards extensively with the result that the tendons and nerves in their hands are damaged. In some cases, the affected people cannot even open doors or shake hands and sometimes need to undergo surgery to solve the problem. Such situations can be avoided by taking frequent breaks while working and using **ergonomic** keyboards (see **section13.1.2**).

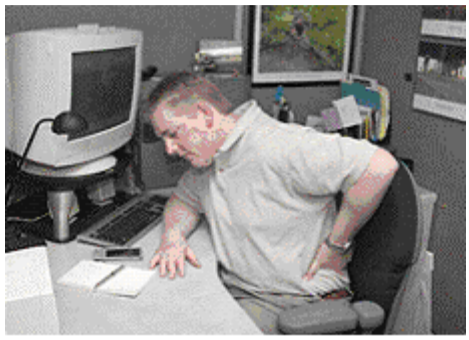


(a) (b)

Figure 13-2 (a) Arm and wrist pain due to improper positioning when working on computers (b) Carpal tunnel syndrome causing pain in the wrist

- **Back and neck pain**
  Monitors, tables, chairs and documents being worked on are often placed at improper positions while working on computers. Consequently many people suffer from back and neck pain. Fortunately many manufacturers are now providing specially designed computer chairs and tables that can be adjusted to the height and comfort of the computer user to avoid such problems. Also computers monitors should be adjusted so that they are at or slightly below eye level and document holders should be adjustable. Footrest as well is recommended to prevent leg fatigue.

(a)



(b)

Figure 13-3 (a) Neck pain resulting from improper position when working on computers (b) Back pain can result when working for long hours and using uncomfortable chair

13.1.2 Ergonomics

Ergonomics in simple terms studies factors that relate humans to the things they use with the aim of designing devices, or methods of working that can be fitted to human abilities instead of doing the reverse. In this way, it is expected that users will not suffer from health risks while at the same time maintaining productivity. Considering the use of computers in the workplace or at home, ergonomics will provide recommendations as to the specifications of the chair, table, computer screen, position, height and seating arrangement required in order to cater for the health of the user. **Figure 13.4** shows such a typical ergonomic arrangement.

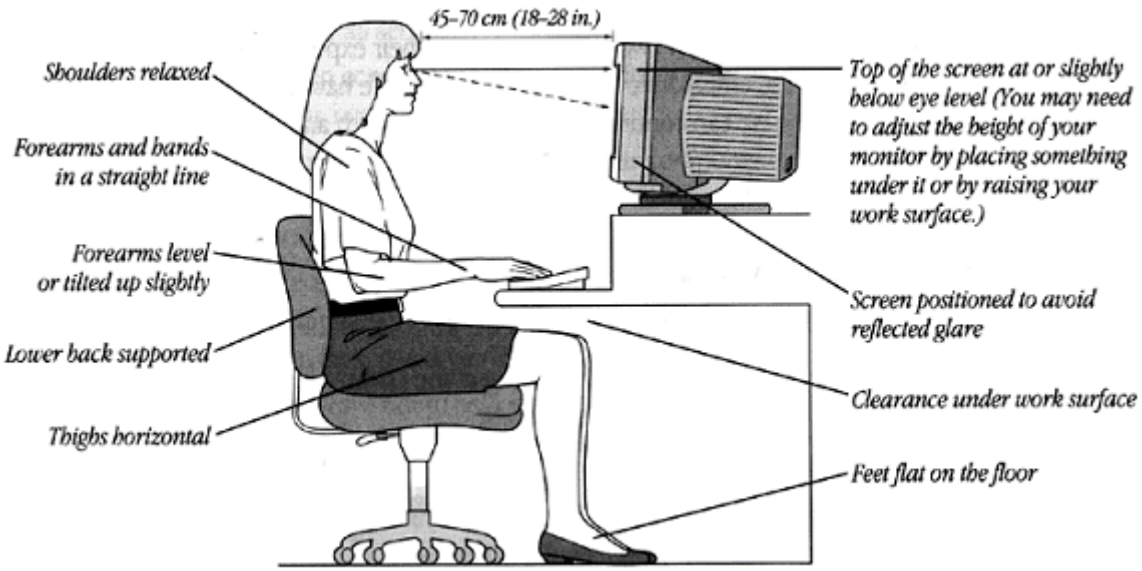


Figure 13-4 Ergonomics applied to computer user

13.2 IT and the Law

During recent years, IT has been at the heart of many disputes whereby people have faced many situations resulting from the misuse of such technology. Some examples include:

- Illegal copying and distribution of software such as Microsoft office suite.
- Intrusion into organizations' computers to steal confidential information such as customer profiles.
- Sending of unsolicited emails (spam) to potential buyers.
- Sending of infected files/viruses over networks.
- Illegal transfer of funds.
- Monitoring networks to steal confidential information such as credit card numbers and passwords.
- Blocking or stopping a service such as an online store like amazon.com or a bank ATM's network.

Consequently there has been an urgent need to define a proper legal framework to protect every individual either directly or indirectly related to IT. The framework consists of carefully defined laws that govern proper use of IT to protect the rights of an individual or an organization. Actually different laws exist for different countries and Mauritius has its own IT related laws. Refer to **Chapter 11**; **Section 11.10** for a few examples of IT related laws in Mauritius.

13.2.1 Copyrights ©

Computers have made it easy to copy and edit materials like music, movies, images and documents that are easily available over networks like the Internet and from secondary storage devices like CDs. Distributing these materials is much easier now and often most of them are copyrighted, meaning that only the authors have the right to use, modify or distribute them. Hence any other individual that copies, modifies or distributes a copyrighted material will be infringing the right of the legitimate author and can be pursued by law. Hence you must seek the permission of the author before using a copyrighted material.

To know whether a material is copyrighted and hence protected under the copyright law, an individual needs to look for the symbol ©, that should appear somewhere on the material concerned. Exceptions to the use, modification and distribution of copyrighted materials do exist however and these are:

1. For research and private study
2. For criticism and review

13.3 Ethics in computing

Ethics govern the moral conduct of an individual. It allows a person to distinguish between what is right to do and what he/she has the right to do. This is particularly important in specialized areas like in medicine. In that case, a doctor should always follow good ethical practices like keeping confidential all medical history of a patient if the latter wishes so. Similarly a people dealing with computers need to follow certain rules that govern their behaviour when using IT. For instance as a university lab computer user, you may have the right to delete the assignment of someone from one of the computers in order to clear hard disk space, but is it ethical to do so? Should you not speak to the person who has written the assignment first? What if it was your assignment and someone else deleted it? And take for instance, the lab technician; what if he purposely allows someone to print a large number of pages while preventing you from printing a single page for no obvious reason. This is really unfair you would say. In practice there are various situations where people dealing with computers tend to abuse technology and unfortunately the law does not make any provision for such acts mostly because it is very difficult to impose such laws. Considering the assignment example, the student has the total freedom of deleting the file since it is a computer that any student should be able to use at their convenience. Does that mean the student who saved his work on that computer is to be blamed? Obviously no, since he/she has also the right to save any work on the computer concerned. Eventually as you can see, there is confusion as to what kind of law to generate and hence ethics as a moral guiding principle is essential here. That is why some professional organizations like the Association of Computing Machinery (**ACM**), British Computer Society (**BCS**) and the Institute of Electronic and Electrical Engineers (**IEEE**) have come up with strict guidelines that give instructions as to how computer professionals and users should be making use of IT. **Figures 13.5 – 13.7** provide a highlight of the guidelines provided by ACM, IEEE and BCS.

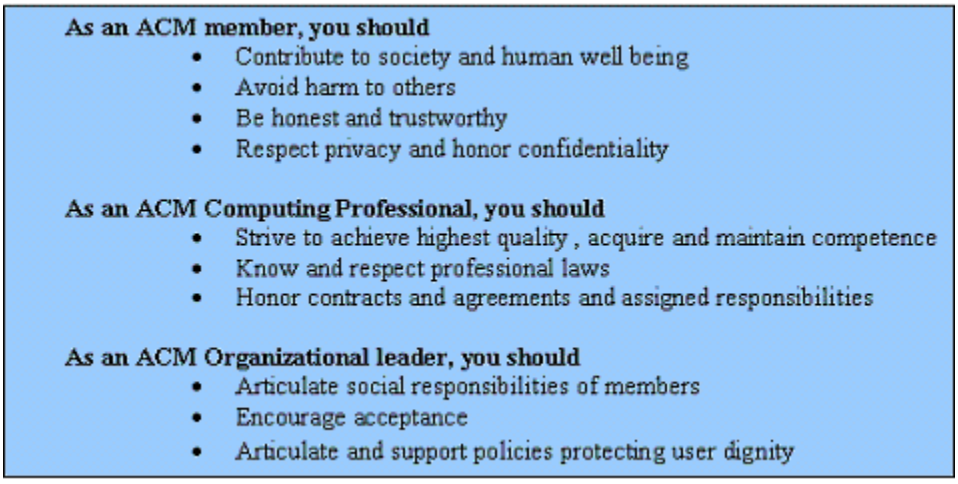


Figure 13-5 Highlights of guidelines for ethical behaviour provided by ACM

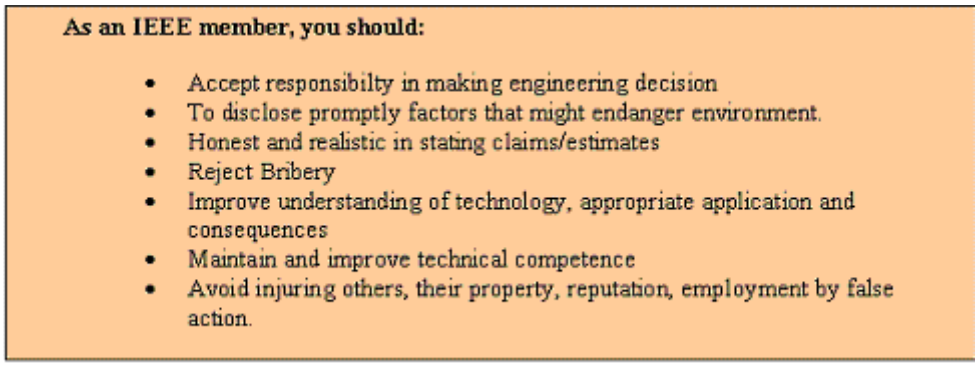


Figure 13-6 Highlights of guidelines for ethical behaviour provided by IEEE

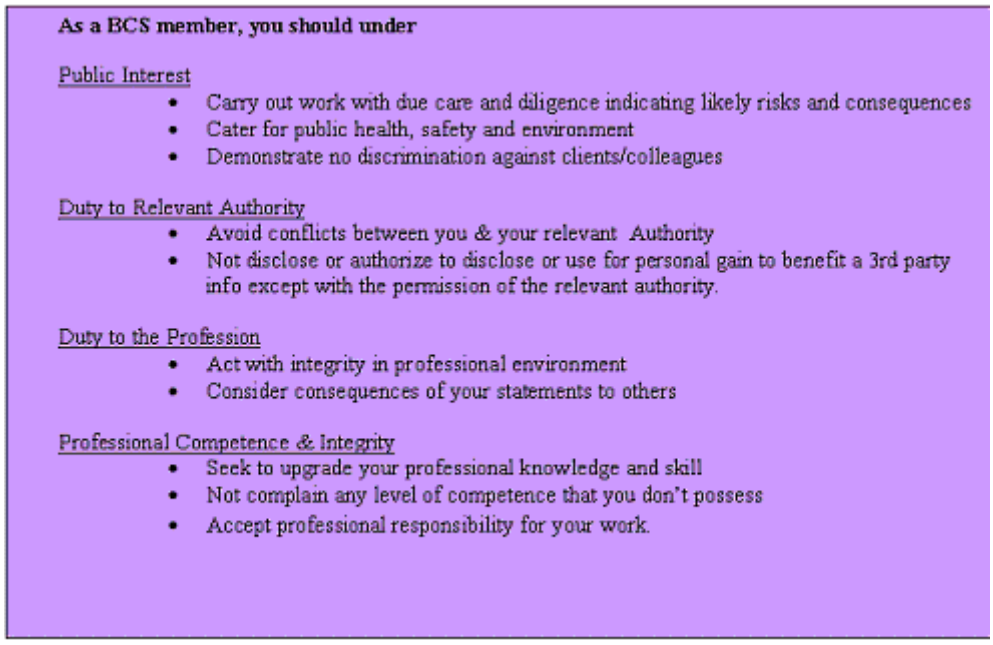


Figure 13-7 Highlights of guidelines for ethical behaviour provided by BCS

In addition to these guidelines, the **Computer Ethics Institute**, comprising of members of the IT professions like IBM and the academic, corporate and public policy communities developed a set of general guidelines known as the "Ten Commandments of Computer Ethics" for the proper use of Information Technology.

The recommendations put forward are as follows:

1. Thou Shalt Not Use A Computer To Harm Other People.

2. Thou Shalt Not Interfere With Other People's Computer Work.

3. Thou Shalt Not Snoop Around In Other People's Computer Files.

4. Thou Shalt Not Use A Computer To Steal.

5. Thou Shalt Not Use A Computer To Bear False Witness.

6. Thou Shalt Not Copy Or Use Proprietary Software For Which You have Not Paid.

7. Thou Shalt Not Use Other People's Computer Resources Without Authorization Or Proper Compensation.

8. Thou Shalt Not Appropriate Other People's Intellectual Output.

9. Thou Shalt Think About The Social Consequences Of The Program You Are Writing Or The System You Are Designing.

10. Thou Shalt Always Use A Computer In Ways That Insure Consideration And Respect For Your Fellow Humans.

However it is important to note that ethics complement the law and hence we need both in order to provide for a secure environment whereby people use Information Technology for the benefits of human beings.

13.4 Trends in IT

Currently there is an ever increasing range of applications that make IT more useful. Traditionally the use of computers was primarily for basic data processing. But with advancements in both processing power and size of computers, the range of applications expanded from word processing, data storage and spreadsheet applications to a wider range of innovative and useful applications. These applications include educational software, desktop publishing, computer-aided design and manufacturing (CAD/CAM), games, modelling and simulation, networking and communications software, electronic mail, the World Wide Web, digital imaging and photography, audio and video applications, electronic commerce applications, groupware, file sharing, search engines, and many others. The growth and diversity of applications greatly increase the utility of IT, leading to its further expansion. This chapter highlights some of the innovative applications that have made a mark in the current decade and will be used for quite some time. The trend in IT is becoming increasingly interdisciplinary in nature. One of the major progresses is wearable technology which is the basis for all future applications. Grid Computing is also making rapid strides. These two technologies form the basis of a wide range of IT applications.

13.5 Wearable Technology

Wearable technology has been in existence for quite some time now. It broadly refers to mobile electronic devices that can be discreetly implanted into the user's outfit as part of the clothing or as an accessory which is operational and can be accessed with minimum

hindrance to the user's normal activity. The basic aim of using a wearable device is to enhance the user's activity and environment in an invisible mode. The most important trait of these devices is that they are context sensitive in nature. By context sensitivity, it is meant that the devices must be able to recognize the change in the user's state and environment. The driving force behind the wearable technology is the ever increasing desire for hands free computing.

Wearable technologies can range from micro sensors which are built into clothes, watches, jewellery to computers which are integrated as a part of the user's accessory. These can be used in several domains and namely health related application domain and smart clothing.

New smart textile and clothing systems are being developed by integrating sensors in the textile constructions. Application fields for these value-added products are protective clothing for extreme environments, garments for the health care sector, technical textiles, sport and leisure wears.

Wearable Technology is proving to be useful in improving the quality and reducing the cost of caring for the aging population, in particular, health monitoring, mobile treatment and nursing. They are mainly used for monitoring patients over extended periods of time. Wearable technology allows clinicians to gather data about the home and community settings. Direct observations concerning the impact of clinical interventions on mobility, level of independence, and quality of life can be performed by means of wearable systems.

Some of the Examples of wearable Technology are given in the **Sections 13.5.1- 13.5.3** that follows.

13.5.1 MIThril

MIThril is indicative of the functionality that can be expected in next generation wearable devices. Apart from the hardware requirements, which include having a wide range of sensors with sufficient computing and communication resources, and the support for different kinds of interfaces for user interaction, including a vest, the device is being designed in a manner that it blends with the user's ordinary clothing and is for a wide range of user behaviours and situations. A simple example is a reminder delivery system, called Memory Glasses, which acts on user specified reminders such as "During my next lecture, remind me to give additional examples of the applications of computers", and requires a minimum of the wearer's attention. Memory Glasses uses a proactive reminder system model that takes into account: time, location and the user's current activities based on daily events that can be detected such as entering or leaving an office.

Figure 13-8 MIThril Jacket from MIT Media Lab.

13.5.2 Charm Badge

Whenever there are conferences, the people attending the conferences make a lot of contacts and the exchange of contact information between people takes up a lot of time. The application of wearable technology in this scenario helps in saving time. The product CharmBadge from Charmed Technology is an electronic business card that can upload and transmit user information through infrared technology. When people register for the conferences, they are given identity badges which have the person's information and areas of interest embedded in them. As the person moves through the conference whenever there is a match of areas of interest, the badges flash indicating that there is a match in the areas of interest and thereby gives the person scope of conversing with the opponent. If the person chooses to converse, then during the scope of conversation, the badges contact each other and keep track of the conversation time. This is further expanded to exhibitions, where the person can keep track of the interesting products and technologies at the stall. Then the information gets stored on to the computer at the conference desktop for further processing (This application makes use of a protocol called Internet Protocol Version 6 (IPV6)). The information is then transferred to a secure website from where the person can download the required information and import them into his / her email application.

Figure 13-9 Charmed Badge Technology

13.5.3 Musical Jacket

Levi's musical jacket is made with the silk organza and is controlled with an all-fabric capacitive keyboard. This keyboard has been mass-produced using ordinary embroidery techniques and conductive thread. The keypad is flexible, durable and responsive to touch. A printed circuit is used to give the keypad a sensing ability, so that the controls react when pressed. The keypad can sense touch due to the increase in capacitance of the electrode when touched. The keypads are connected to a miniature MIDI synthesizer that plays music. Power could be supplied by a parasitic power source such as solar power, wind, temperature or mechanical energy from turning wrists or walking. Currently researchers are looking for fabrics capable of generating power as they flex.

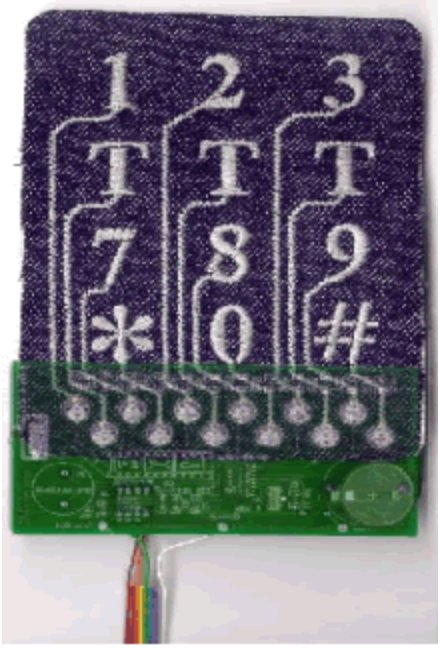


Figure 13-10 Musical Jacket Keypad from MIT Media Lab

13.6 Grid Computing

In simplest terms, grid computing is the pooling of all IT resources into a single set of shared services for all enterprise computing needs. Grid computing infrastructure continually analyzes demand for resources and adjusts supply accordingly. It works on the principle of applying the resources of many computers in a network to a single problem at the same time – usually a scientific or technical problem that requires a great number of computer processing cycles or access to large amounts of data for solving problems too intensive for any stand-alone machine.

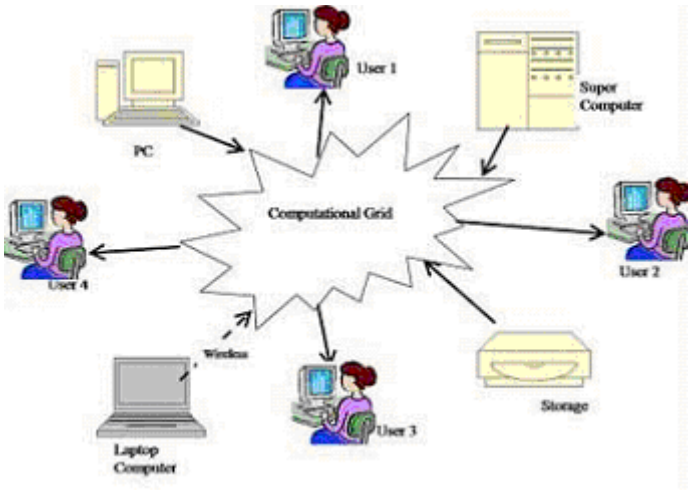


Figure 13-11Grid Computing

Grid computing uses software to divide and process pieces of a program to as many as several thousand computers. A number of corporations, professional groups and university consortia have developed frameworks and software for managing grid computing projects.

Perhaps the most ambitious is Oxford University's Centre for Computational Drug Discovery's project that utilizes more than one million PCs to look for a cancer cure. People around the world donate a few CPU cycles from their PCs through "screensaver time." The project eventually will analyze 3.5 billion molecules for cancer-fighting potential. More than 50,000 years of CPU power (based on a 1.5 gigahertz chip) have been put to work so far. Other examples include SETI.

Bio-informatics* is another area where grid computing is very useful. Grid computing is used in genome projects** .

*Bio-Informatics is the use of computers in solving information problems in the life sciences. It mainly involves the creation of extensive electronic databases on genomes, protein sequences etc. Also involves techniques such as three-dimensional modeling of bimolecular and biological systems

**Genome is the total genetic composition of an individual. The complete genetic information possessed by an organism.

13.7 New Trends

13.7.1 Smartcards Technology

A smart card, a type of chip card is a plastic card embedded with a computer chip that stores and transacts data between users. This data is associated with either value or information or both and is stored and processed within the card's chip, either a memory or microprocessor. The card data is transacted via a reader that is part of a computing system. Smart card-enhanced systems are in use today throughout several key applications, including healthcare,

banking, entertainment and transportation. To various degrees, all applications can benefit from the added features and security that smart cards provide. Smart cards greatly improve the convenience and security of transactions. They provide tamper-proof storage of user and account identity. Smart cards also provide vital components of system security for the exchange of data throughout virtually any type of network. They protect against a full range of security threats, from careless storage of user passwords to sophisticated system hacks. Multifunction cards can also serve as network system access and store value and other data.

Figure 13-12 Smart Card

The most common smart card applications are:

- Credit cards
- Electronic cash
- Computer security systems
- Wireless communication
- Loyalty systems (like frequent flyer points)
- Banking
- Satellite TV
- Government identification

13.7.2 Biometrics

Biometrics refers to the automatic identification of a person based on his/her physiological or behavioral characteristics. This method of identification is preferred over traditional methods involving passwords and PIN numbers for various reasons: The person to be identified is

required to be physically present at the point-of-identification; Identification based on biometric techniques obviates the need to remember a password or carry a token. With the increased use of computers as vehicles of information technology, it is necessary to restrict access to sensitive/personal data. By replacing PINs, biometric techniques can potentially prevent unauthorized access to or fraudulent use of ATMs, cellular phones, smart cards, desktop PCs, workstations, and computer networks. PINs and passwords may be forgotten, and token based methods of identification like passports and driver's licenses may be forged, stolen, or lost. Thus biometric based systems of identification are receiving considerable interest. Various types of biometric systems are being used for real-time identification, the most popular are based on face, iris and fingerprint matching. However, there are other biometric systems that utilize retinal scan, speech, signatures and hand geometry.

A biometric system is essentially a pattern recognition system which makes a personal identification by determining the authenticity of a specific physiological or behavioral characteristic possessed by the user. An important issue in designing a practical system is to determine how an individual is identified. Depending on the context, a biometric system can be either a verification (authentication) system or an identification system.

Figure 13-13 A computer mouse with a built-in fingerprint scanner (Source Siemens)

Biometrics is a rapidly evolving technology which has been widely used in forensics such as criminal identification and prison security. Recent advancements in biometric sensors and matching algorithms have led to the deployment of biometric authentication in a large number of civilian applications.

(a) (b) (c)

Figure 13-14 (a), (b) and (c) illustrate the use of biometric in Face Recognition, Iris Recognition and hand geometry matching respectively.

Biometrics can be used to prevent unauthorized access to ATMs, cellular phones, smart cards, desktop PCs, workstations, and computer networks. It can be used during transactions conducted via telephone and Internet (electronic commerce and electronic banking). In automobiles, biometrics can replace keys with key-less entry and key-less ignition. Due to increased security threats, many countries have started using biometrics for border control and national ID cards. However a biometric system which relies only on a single biometric identifier in making a personal identification is often not able to meet the desired performance requirements. Identification based on multiple biometrics represents an emerging trend. A multimodal biometric system, which integrates face recognition, fingerprint verification, and speaker verification in making a personal identification, is a better option. This system takes advantage of the capabilities of each individual biometric. It can be used to overcome some of the limitations of a single biometrics. Preliminary experimental results demonstrate that the identity established by such an integrated system is more reliable than the identity established by a face recognition system, a fingerprint verification system, and a speaker verification system.

13.7.3 Telemedicine

As the health care system continues to change and adapt to the new realities associated with finance and management restructuring, the technological side of patient care also has changed. Telemedicine is the use of electronic information and communication technologies to provide and support health care when distance separates the participants. It is a system that connects primary care physicians, providers, specialists and patients. Telemedicine is not a new concept. It has existed for a number of years in the form of the telephone and fax machines. In recent years, with the improvements made in access, technology, and communications systems, telemedicine has expanded and, in a time of limited resources, has become a feasible alternative for smaller and rural medical facilities to provide routine and specialized services. Particularly in rural areas, it offers the potential of both improved access

to care and improved quality of care. The primary applications of telemedicine are clinical, educational, administrative, and research. Clinical applications include initial patient evaluations, diagnosis (telediagnosis), and consultation (teleconsultation). Physician supervision of non- physicians and monitoring of patient status are possible. Continuing education for professionals is available, as is patient and community education (tele-education). Administrative uses, such as conferences, scheduling, and utilization and quality review may be provided. Research is enhanced by aggregation of data from multiple sources and coordination. Telemedicine allows access to the wealth of information available on the Internet. This allows information to be at the touch of a finger. The availability of e-mail allows an efficient mechanism of communication between consulting and primary physicians. Communication between facilities is enhanced.

Figure 13-15 A typical Telemedicine Scenario

Telemedicine allows patients to receive medical care in their own community. This increases the financial viability of rural medical facilities and strengthens the rural economy by keeping the flow of resources in local communities. Telemedicine assists in providing specialty care services to rural areas and provides more efficient use of medical resources which may lessen the amount of travel time for both patients and the specialist. Continuity of patient care is enhanced when the patient, primary care physician, specialist and family members are involved during a consultation. Should the patient be required to be transferred to an urban facility, they have already met the physician who will be caring for them. Physicians and on-site care providers benefit as they receive quick and efficient consultations. The sense of isolation experienced by rural physicians is also reduced. The formation of health care networks between rural and urban facilities provides benefits to both. Urban based facilities provide accessibility of health care to rural areas. However, there are telemedicine networks where the excess capacity of rural facilities can be tapped into to benefit urban patients. It is possible that during peak times rural physicians may be accessed via telemedicine to provide more timely care to patients waiting in congested urban emergency rooms.

13.7.4 Virtual Reality

An artificial environment created with computer hardware and software. To "enter" a virtual reality, a user wears special gloves, earphones, goggles and/or full-body wiring. In addition to feeding sensory input to the user, the devices also monitor the user's actions. The goggles, for example, track how the eyes move and respond accordingly by sending new video input.

Virtual reality is well known for its use with flight simulators and games. However, these are only two of the many ways virtual reality is being used today.

- **Medicine**: A prototype surgical assistant for simulation of paranasal surgery has been developed. During a simulated operation the system provides vocal and visual feedback to the user, and warns the surgeon when a dangerous action is about to take place. In addition to training, the expert assistant can be used during the actual operation to provide feedback and guidance. This is very useful when the surgeon's awareness of the situation is limited due to complex anatomy.

- **Architecture**: There is virtual reality program has applications in the area of architecture and light engineering. With light simulation architects can examine how outdoor light will fall inside and outside their building before it is built. If the lighting needs to be redesigned, the architect can redesign the building on the computer and examine the new outdoor light effects. In addition to outdoor light, lighting engineers use virtual reality to examine the effects of point lights, spotlights and other indoor light sources. An interior designer could examine how light will affect different room arrangements.

- **Weather Simulation**: There is a system for weather forecasting which accepts data from meteorological services such as satellite data, statistically corrected forecast data, precipitation data and fronts information. It then analyzes this data and uses fractal functions to create projections of storm systems. Using this system to visualize artificial clouds, meteorologists can predict weather with increased accuracy.

- **Chemistry**: Real Mol is a program that uses virtual reality to show molecular models in an interactive, immersive environment. The scientist who uses the program wears a cyberglove and a head mounted display to interact with the molecular system. Using RealMol scientists can move molecules or protein chains to create new molecules. This is useful in fields such as drug design. RealMol displays molecules in three ways: ball and stick model, stick model and CPK model. The molecules are rendered through a molecular dynamics simulation program.

Other Applications of Virtual Reality include Flight Simulator; Museums and Cultural Heritage; Financial Data and Training and Hubble Telescope

13.7.5 IP Television

With the advent of high speed networks resulting in high bandwidth, it is now possible to watch television channels using the internet on either a computer or a television. The IP refers to a method of sending information over a secure, tightly managed network that result in a superior entertainment experience. IPTV allows the service provider to deliver only those channels that the consumer wants at any given time -- unlike traditional television broadcasting, where every channel is delivered to every home on the network. For the first time, it will be economical to deliver a college football game to everyone who wants to see it, for example, rather than just a particular local community. IPTV gives the viewer access not just to an event but to the information related to it. Since the network is a secure data network, it allows the viewer the ability to look up player-specific information right on the

TV while watching a game. It also enables the viewer to send photos or home movies from the computer right onto the television, message his/her friends while the viewer watches a show "together" across great distances, and receive caller ID information on the TV. It also allows the flexibility of watching the programs according the convenience of the user or uses a cell phone to manage his/her children's TV viewing when he/she is away from home. This service is being provided by Mauritius telecom in Mauritius to the ADSL subscribers.

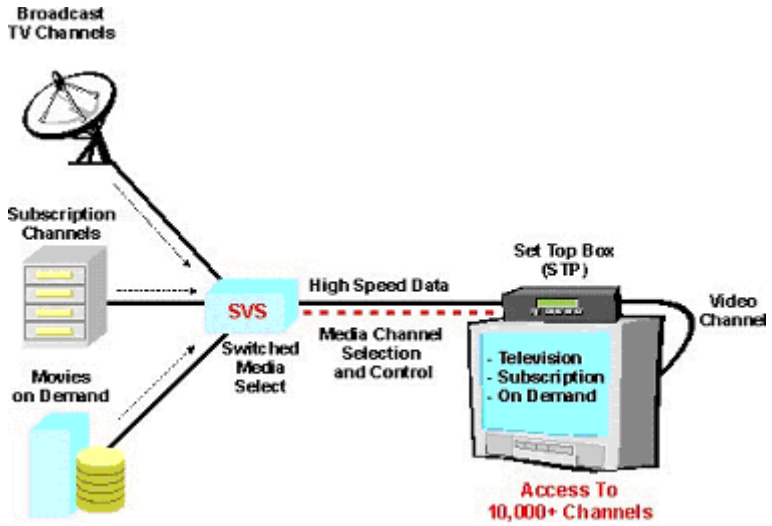


Figure 13-16 IP Television

The basic setup to use IPTV includes the venerable set-top box. The box will connect to the home DSL line and is responsible for reassembling the packets into a coherent video stream and then decoding the contents. This enables the users to view the channels on the television rather than on the computer.

13.7.6 Digital Libraries

Digital library is a collection of digital objects. A collection of research papers is a typical example. When this collection gets sufficiently large, users of the digital library cannot examine each paper individually to find if its subject interests them. To address this problem, digital librarians create an interface to stand between the content of the collection and the user. In a traditional library, an example of this would be a card catalog - a collection of small cards that represent the larger objects contained in the collection. These cards are more manageable than the books that they represent.

In a digital library, there are a number of ways that we can present the digital collection to the user. The first thing that we need to do is to describe each object in a manageable way. This description is called metadata - data (the description) about data (the digital object). This metadata is more manageable than the digital objects that it represents. Metadata is written in a standard format. This allows the metadata to be manipulated using automated tools.

A digital library is like a “regular” library except: contents digitized, services computerized, and clientele delocalized. A digital library also has mechanisms and policies for forming/managing combinations of contents, services, and clientele computationally

automated/enhanced. The purpose of a digital library is to provide access to digital content in a variety of formats.

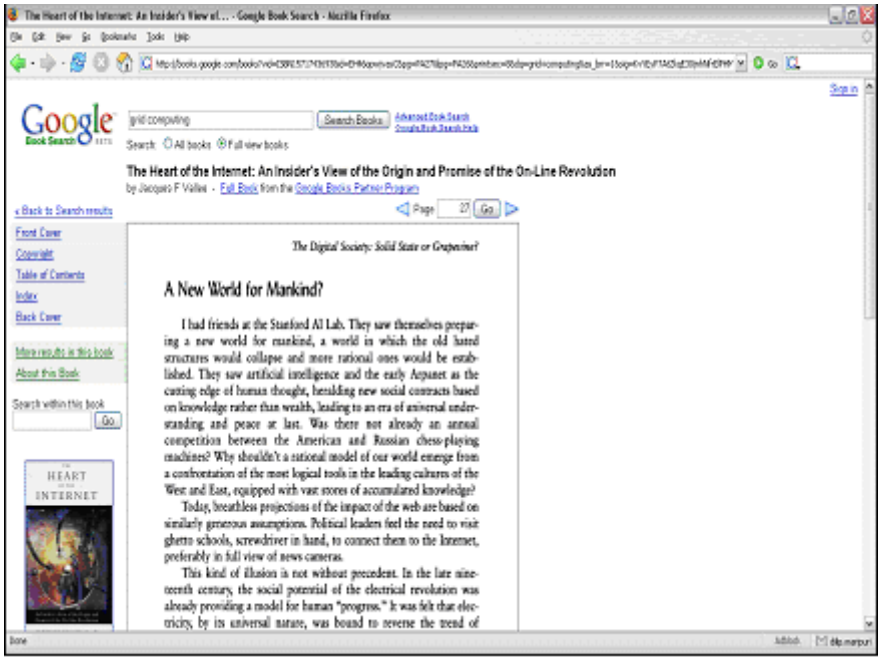


Figure 13-17 Google's Digital Library